

Abstract Submitted to the
International Conference on Strongly Correlated Electron Systems
University of Michigan, Ann Arbor
August 6-10, 2001

Orbitons in LaMnO_3

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LaMnO_3 is an orbital-ordered, strongly correlated electron system. There is a long-standing prediction that in an orbital-ordered state modulations of the electronic wavefunctions should give rise to collective excitations. Only this year the existence of these 'orbitons' was experimentally verified in a Raman scattering experiment¹.

There are two distinct physical mechanisms that can cause orbital order: the electron-electron repulsion and electron-lattice interaction, where the latter gives rise to a cooperative Jahn-Teller distortion in LaMnO_3 . Along the lines of this dichotomy, the observed orbitons are interpreted to be either due to electron correlations¹, or due to lattice dynamics². I propose that in LaMnO_3 there is both a correlation *and* dynamical lattice contribution to the orbital excitation. The orbion is therefore an intrinsically mixed mode and in the Raman experiment the lattice character of this mode is probed. Within this framework, a detailed model calculation shows that in the phonon excitation spectrum weak satellites appear at the orbion energy, in qualitative and quantitative agreement with the experimental observation.

¹E. Saitoh *et al.*, Nature **410**, 180 (2001).

²P.B. Allen and V. Perebeinos, Nature **410**, 155 (2001).